

# Low Cost Options for Moderate Levels of Mercury Control

## TOXECON II™ and High Temperature Sorbents



**DOE/NETL Mercury Control Technology Conference**

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**DOE/NETL Project Manager: Andrew O’Palko**

**DOE Cooperative Agreement DE-FC26-05NT42307**



# ***MidAmerican's Louisa High Temperature Sorbent Test***

- **MidAmerican's Louisa Unit 1**
  - 700 MW
  - Test full unit
  - PRB Coal
- **Hot Side ESP**
  - Four boxes
  - Five mechanical fields
  - 459 SCA
- **Project goal**
  - 50-70% Hg removal
- **Ash resold**
  - Ash disposal per normal plant operations



## **Test Results:**

ADA-37 – No correlation with enhanced Hg removal

KNX – Increased speciation, no enhanced Hg removal

# ***MidAmerican's Council Bluff Unit 2 High Temperature Sorbent Test***

- **MidAmerican's Council Bluff Unit 2**
  - 88 MW
  - Test full unit
  - PRB Coal
- **Hot Side ESP**
  - One box
  - Four mechanical fields
  - 224 SCA
- **Project goal**
  - 50-70% Hg removal
- **Ash resold**
  - PAC/ash disposal plans under discussion



## **Tentative Test Plans**

MinPlus – furnace injection

PAC – injection upstream of ESP

Spring 2007

# TOXECON II™ Full-Scale Evaluation

- **Entergy's Independence Steam Electric Station**
  - 880 MW
  - Test on 1/8 of Unit 2
  - PRB Coal from North Antelope
- **Cold Side ESP**
  - Four boxes
  - Eight electrical fields per box (32 total)
  - 540 SCA
- **Project goal**
  - 50-70% Hg removal



- **Ash sold for concrete**
  - PAC/ash routed to separate silo during tests

# TOXECON II™ Evaluation Co-funders

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Alliant

Atco Power

DTE

**Entergy\***

Oglethorpe Power

Southern Company

Xcel Energy

ADA-ES

Arch Coal

EPCOR

EPRI

NORIT Americas

*\* Host Sites*



The logo for the Electric Power Research Institute (EPRI) consists of the letters "EPRI" in a white, sans-serif font. The letters are centered within a solid blue rectangular box.

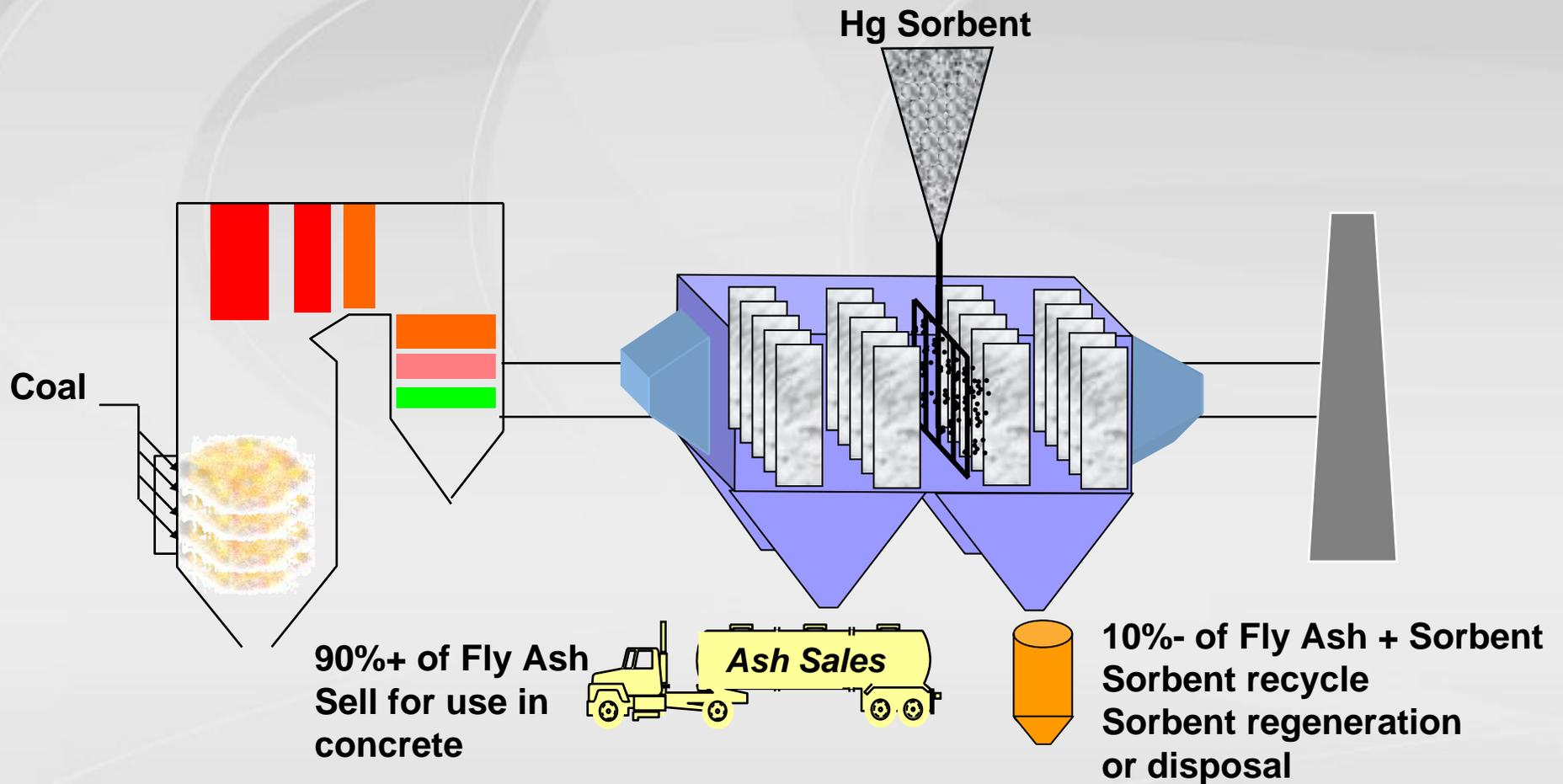


# Project Objectives

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- Determine the cost and effects of sorbent injection using EPRI's TOXECON II™ process for control of mercury in stack emissions

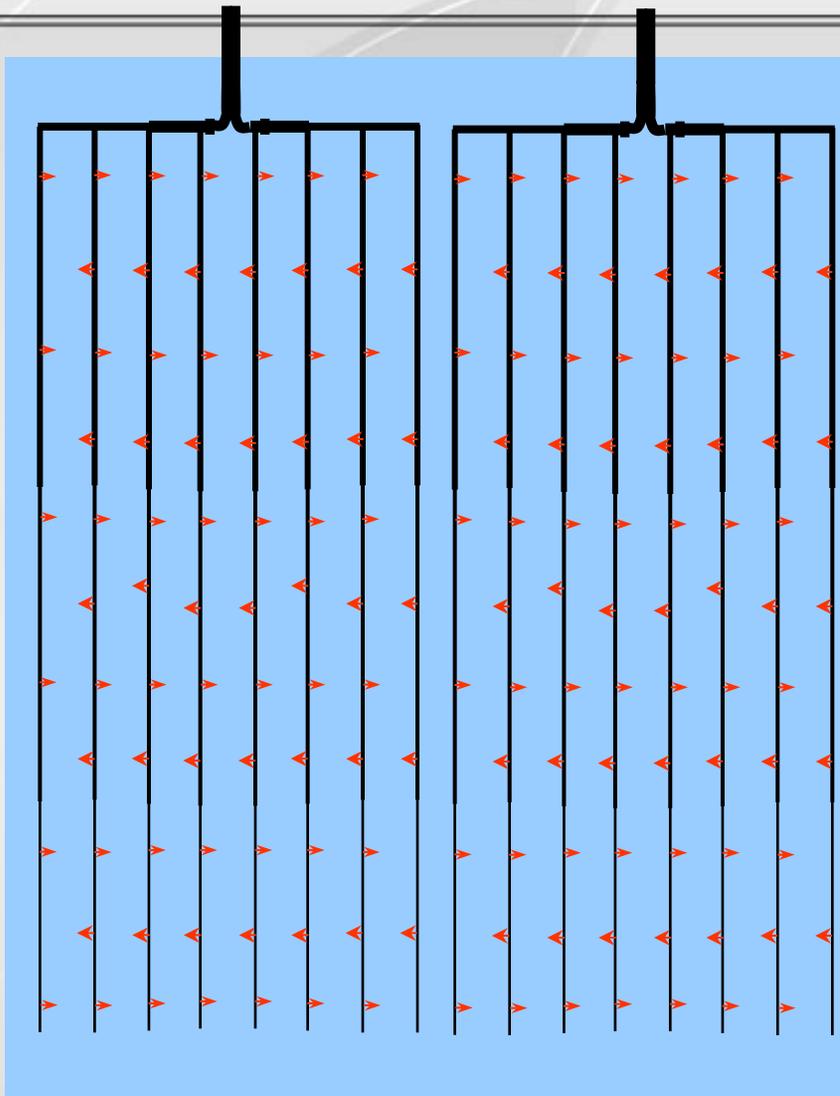
# EPRI TOXECON II™ Configuration



# Test Equipment



# Lance Configuration



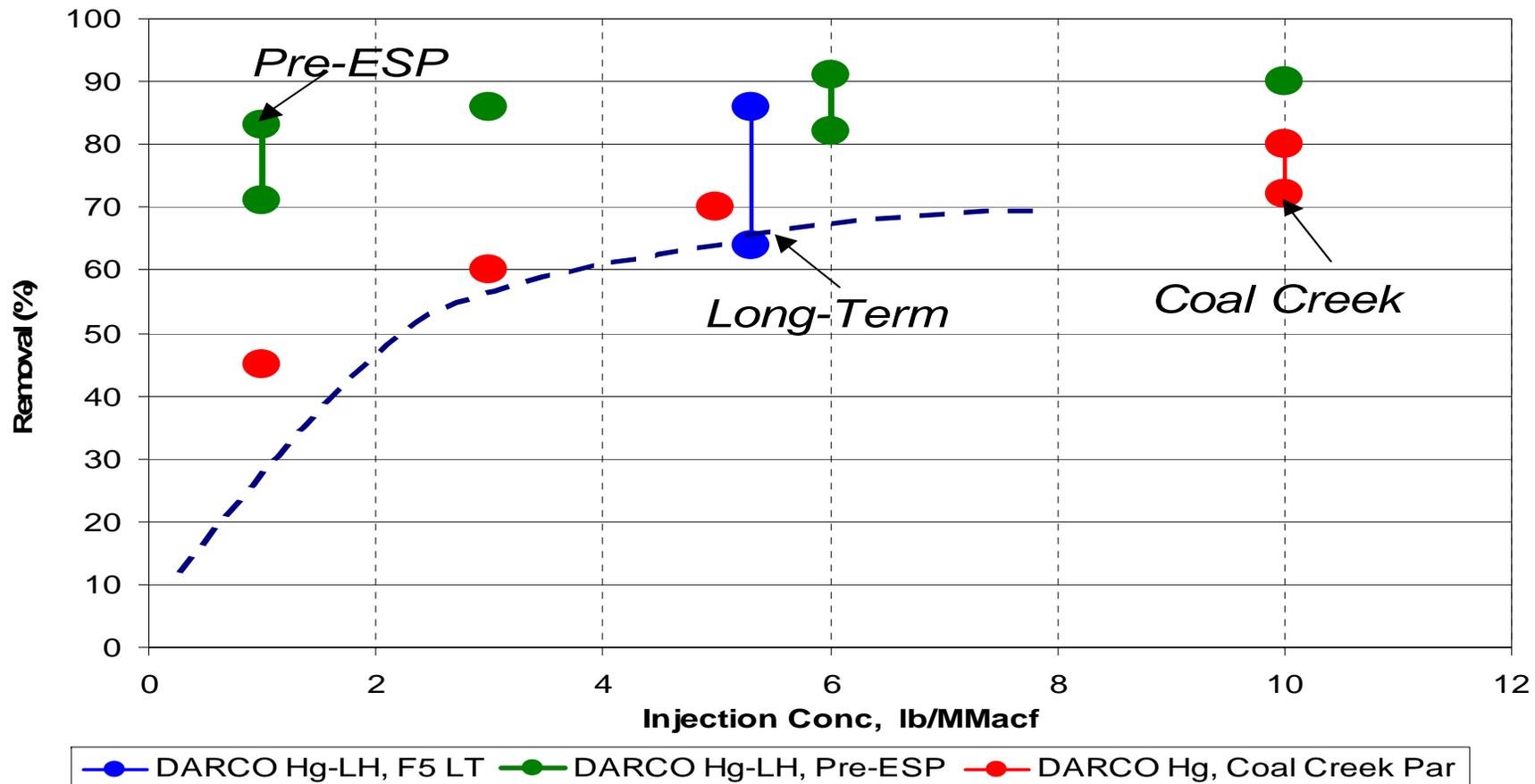
- 16 lances in  $\frac{1}{2}$  of one ESP box
- $\frac{1}{8}$  of Unit 2 flow treated
- ~ 42-feet long, 33-inch spacing
- 11 nozzles per lance

Test-Side of ESP Box

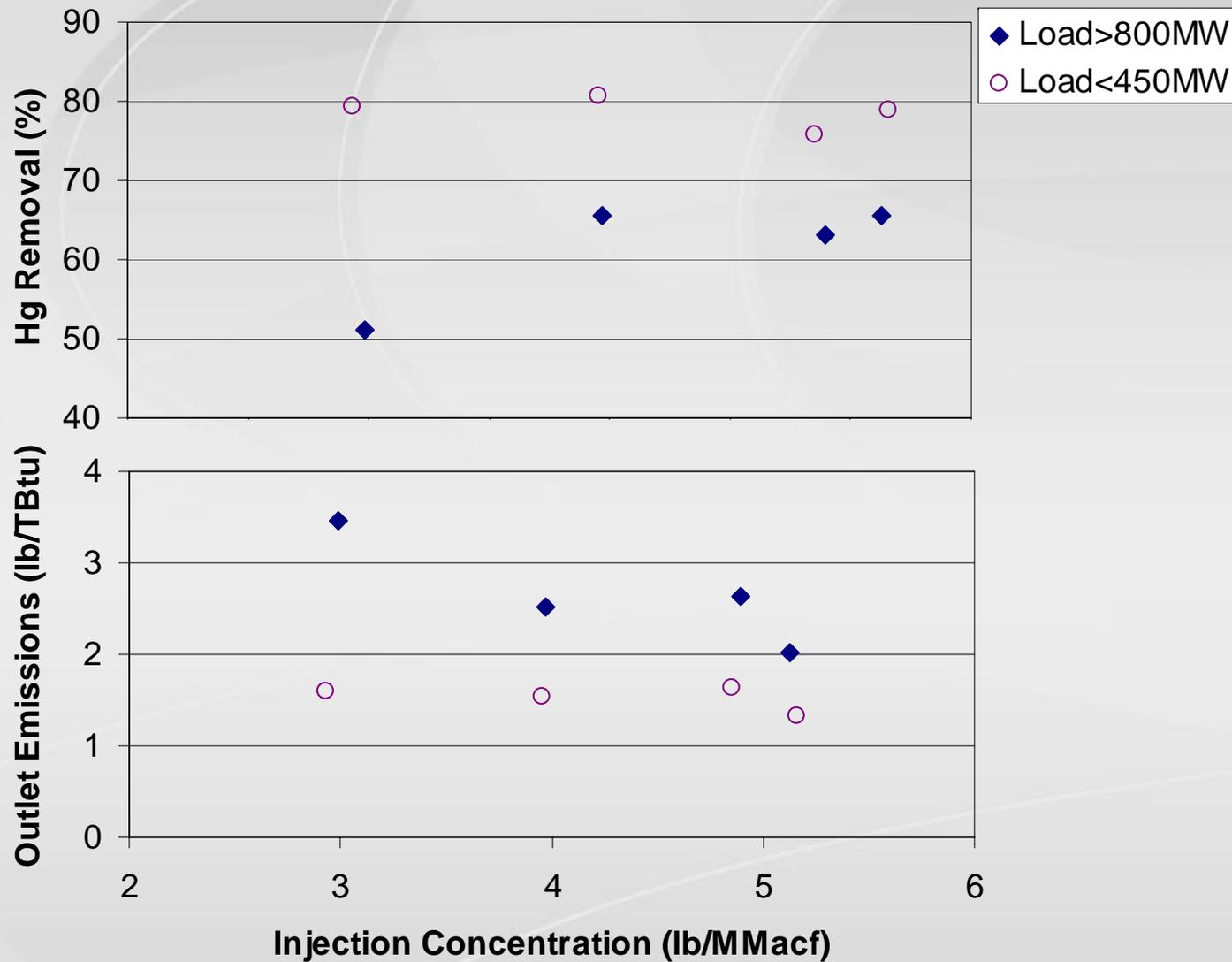
Control-Side of ESP Box



# Mercury Removal Results Comparisons



# Long-Term Performance Results



# Test Results – Balance of Plant

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- Opacity
  - Some opacity spikes measured during last field rapping while operating at reduced ESP power
  - Testing with full ESP power and varying the rapping sequence limited the particulate and opacity spikes for all sorbents tested
- Minimal other plant impacts

## Test Results – Summary

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- Achieved project goal of 50 to 70% Hg removal
- TOXECON II™ Hg removal limited to < 80% at full load with up to 8 lb/MMacf DARCO® Hg-LH
- Hg removal > 80% with pre-ESP injection of DARCO® Hg-LH at 1 to 2 lb/MMacf
- TOXECON II™ Hg removal varied significantly with load (lower removal at high load)

*Physical and CFD modeling indicate lower-than expected TOXECON II™ results due to poor carbon distribution*

# Physical Modeling #1

## Plume Penetration

Existing blower design:  
Poor coverage

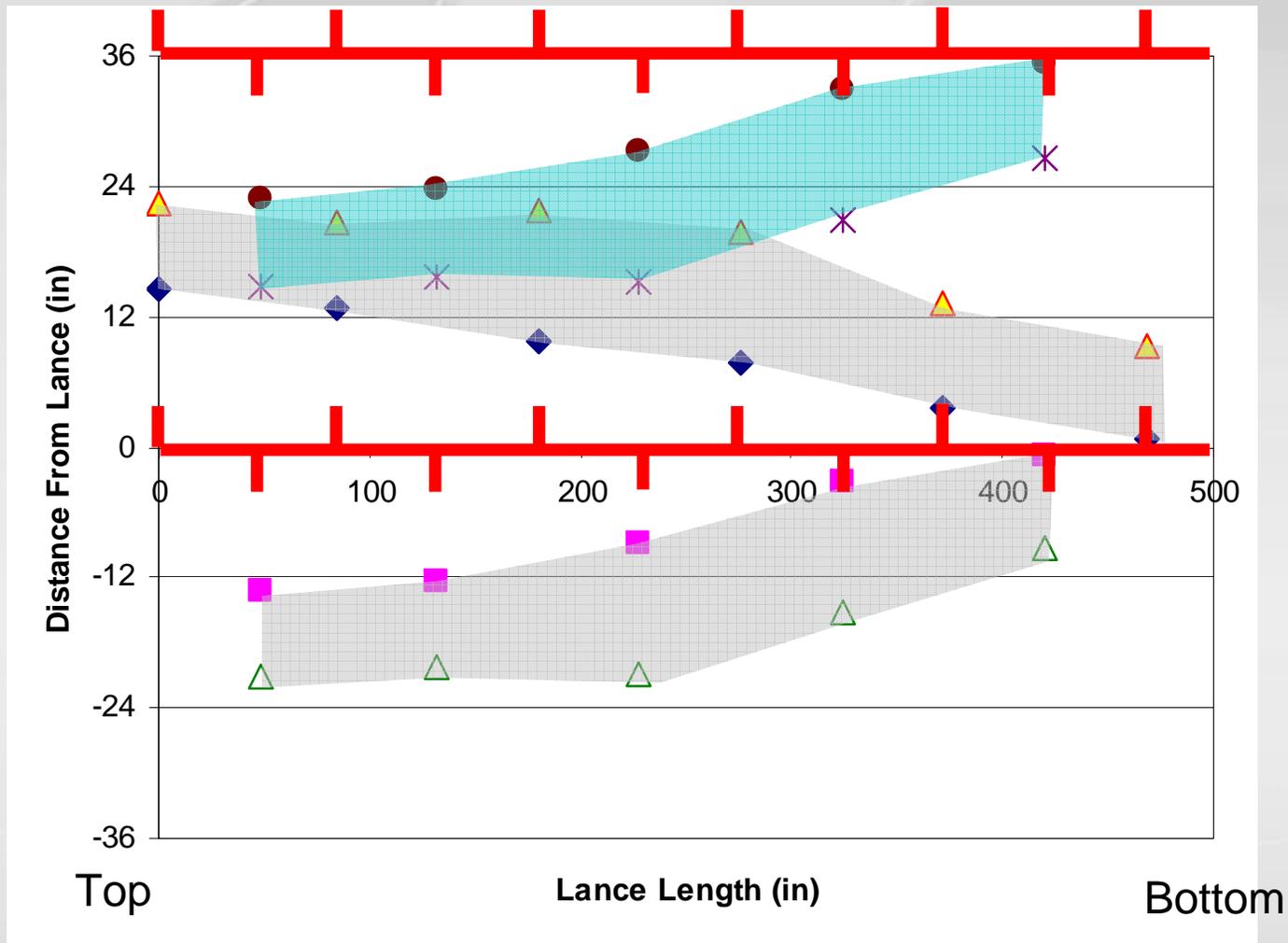


Increased air flow to  
lances = increases  
penetration distance

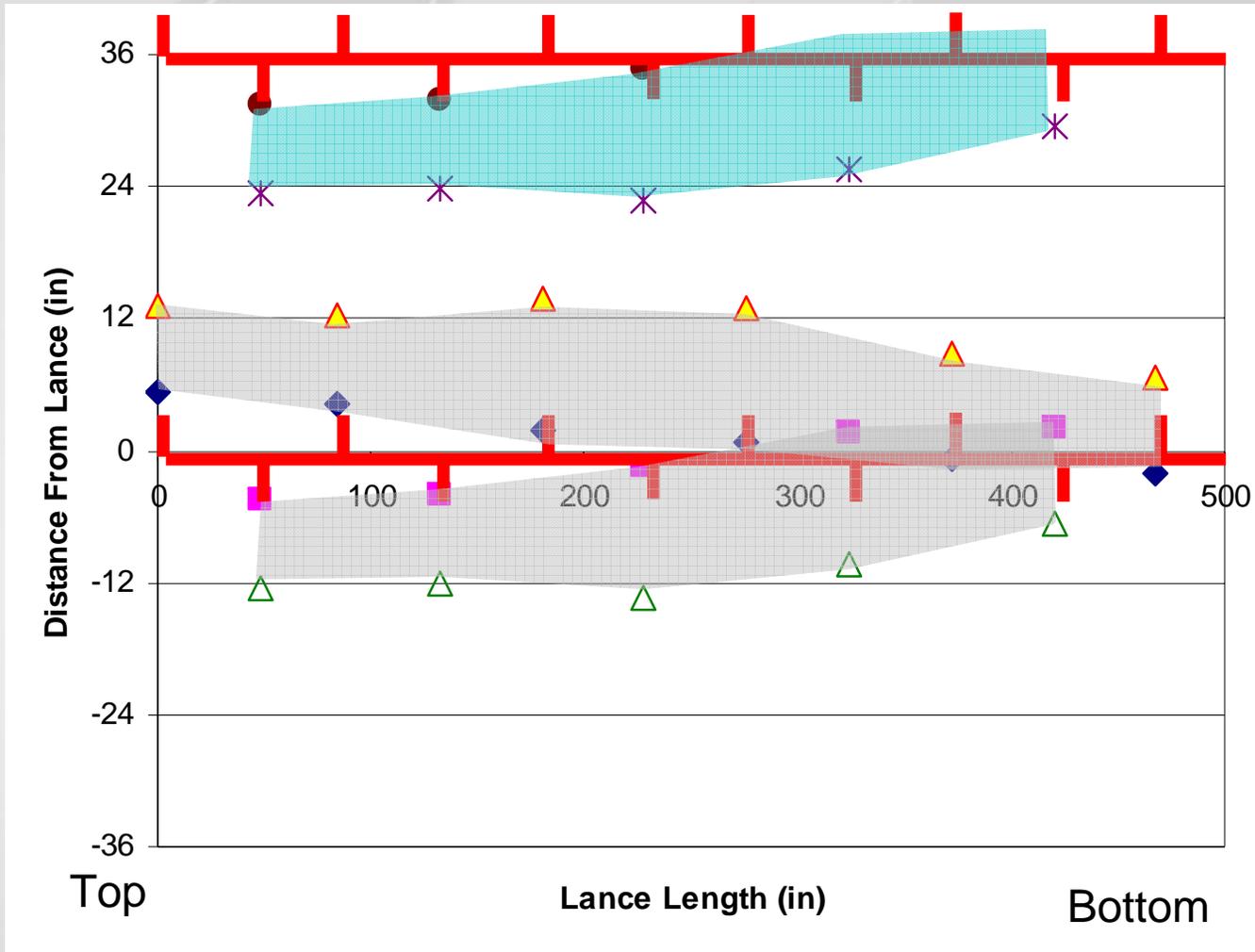
Performed by NELS



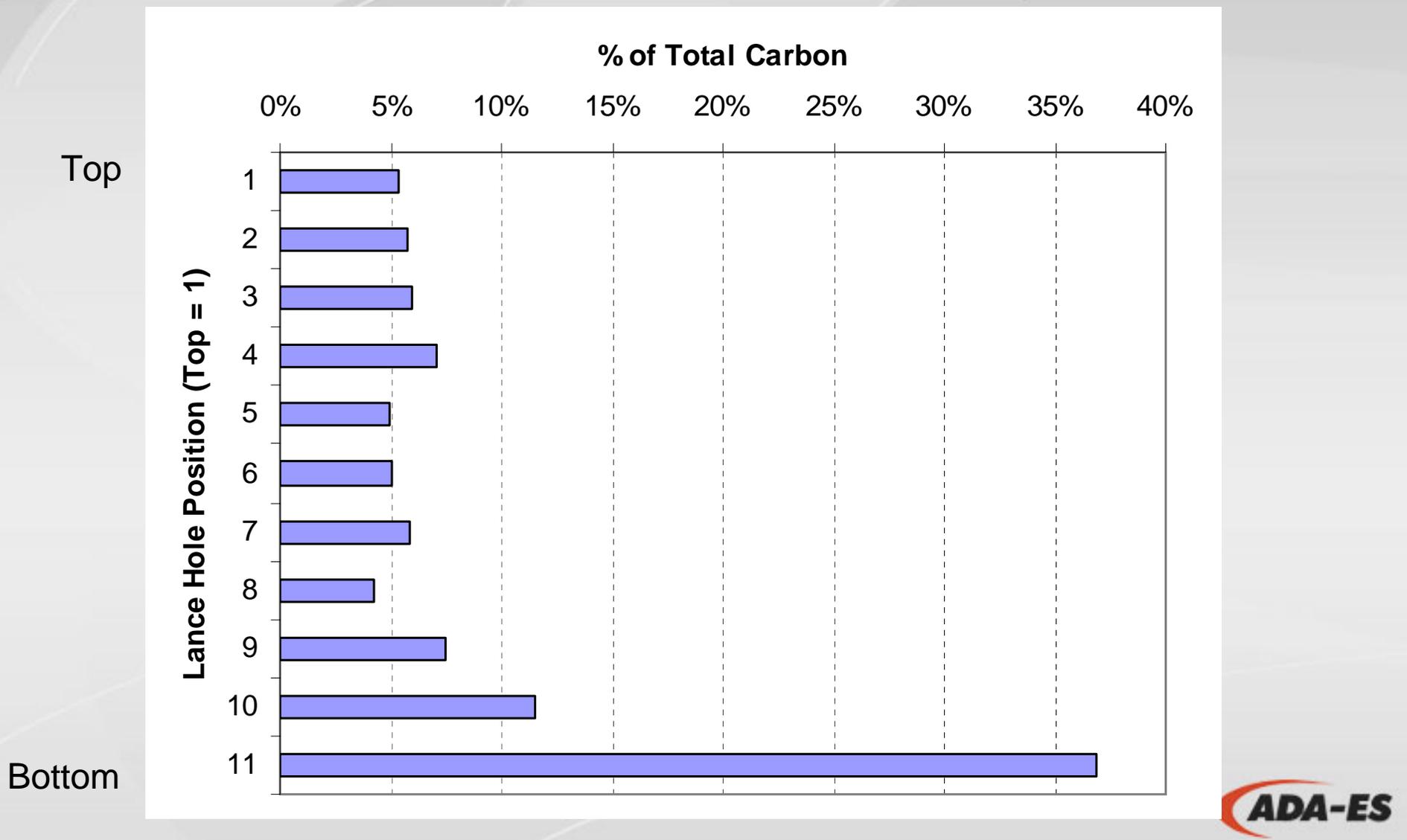
# Original Lance Design – Low Load



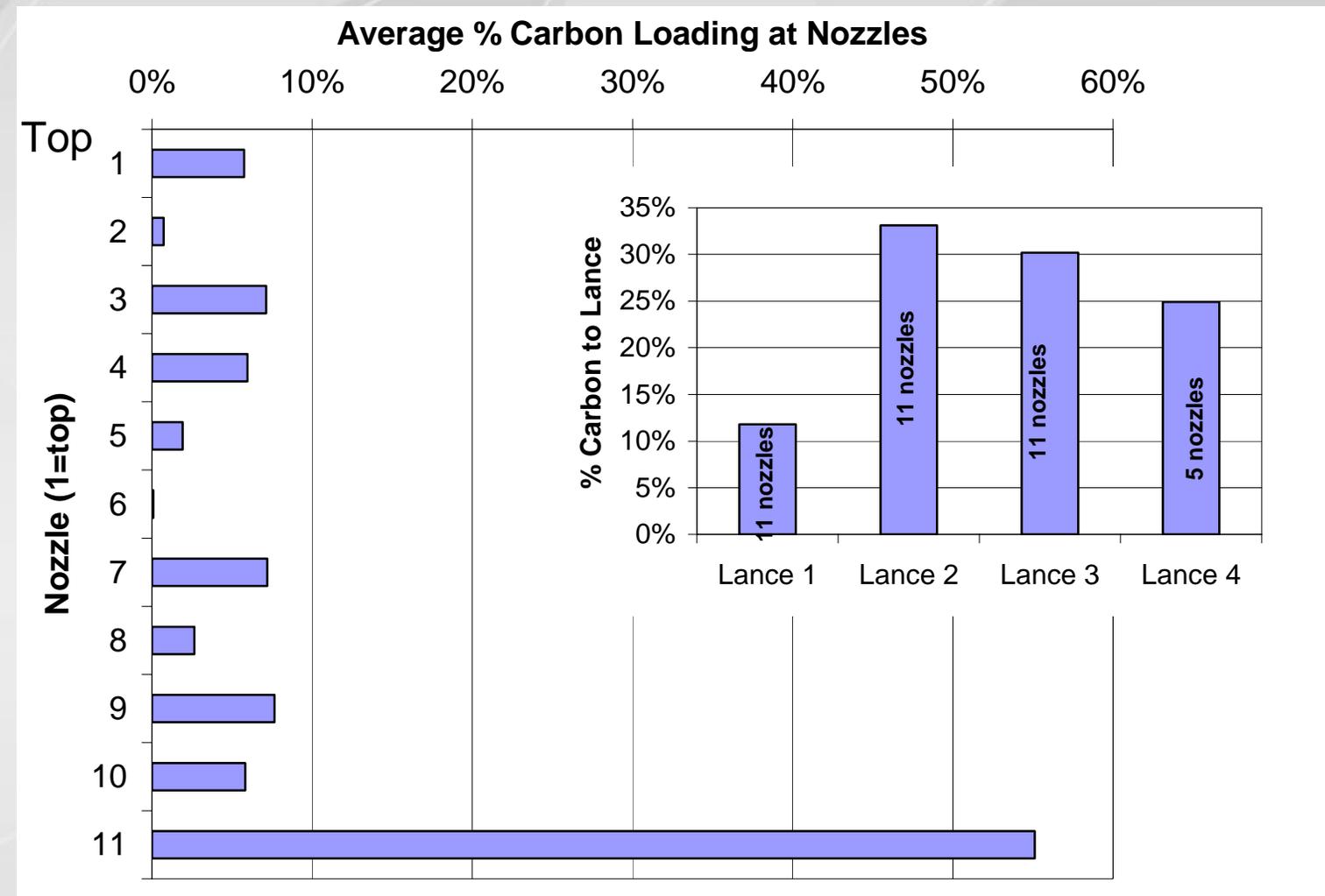
# Original Lance Design – High Load



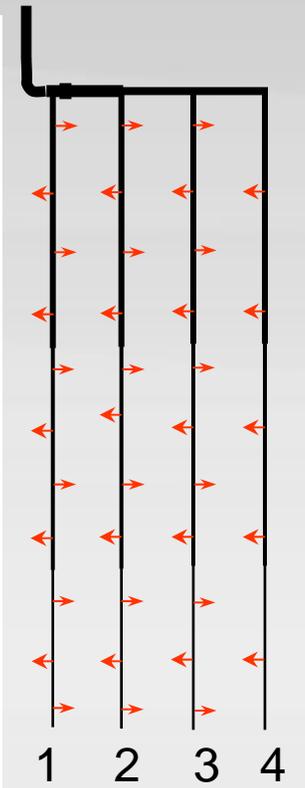
# Carbon Distribution – Physical Model



# Carbon Distribution – CFD Model



Bottom

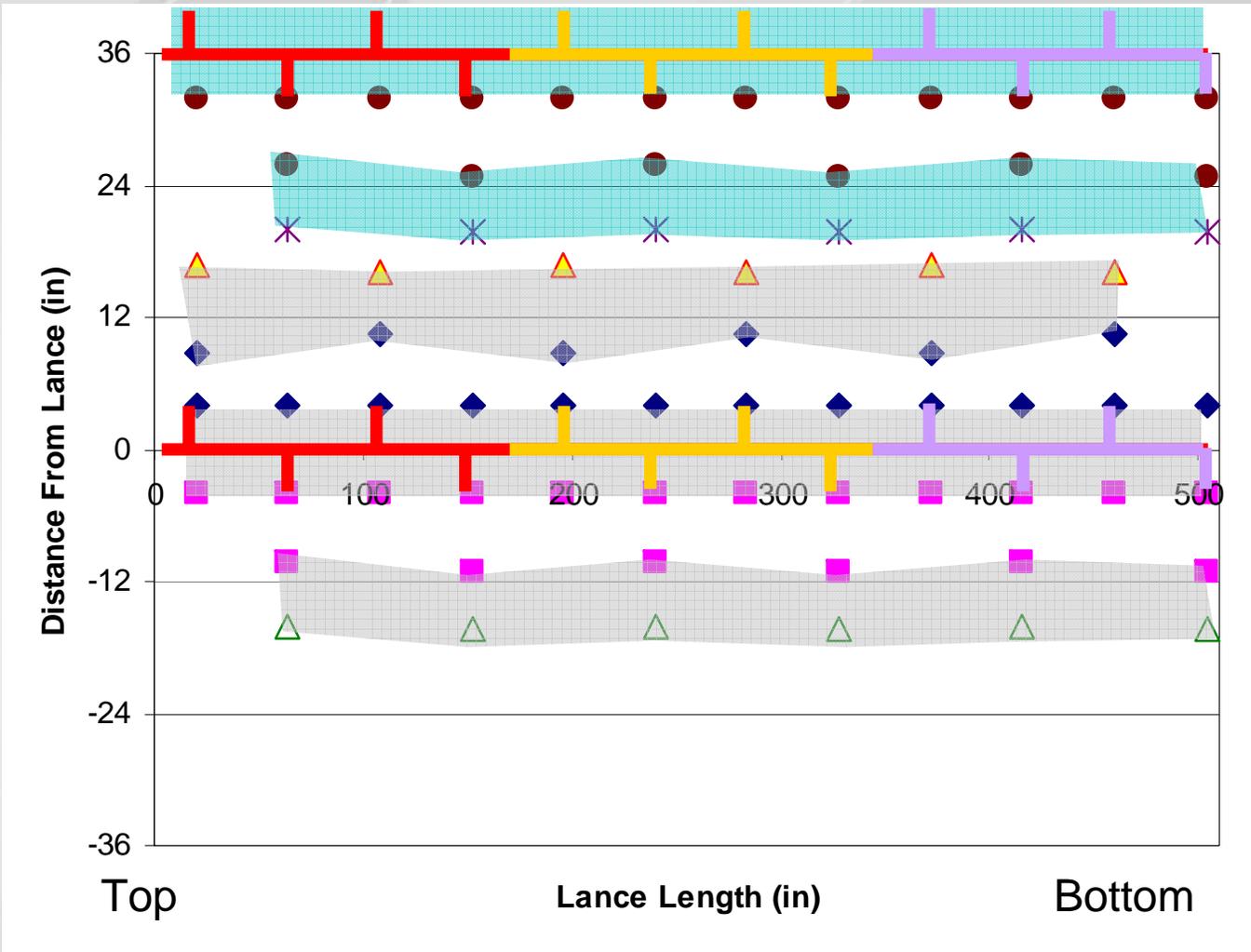


# Plans for Additional Testing

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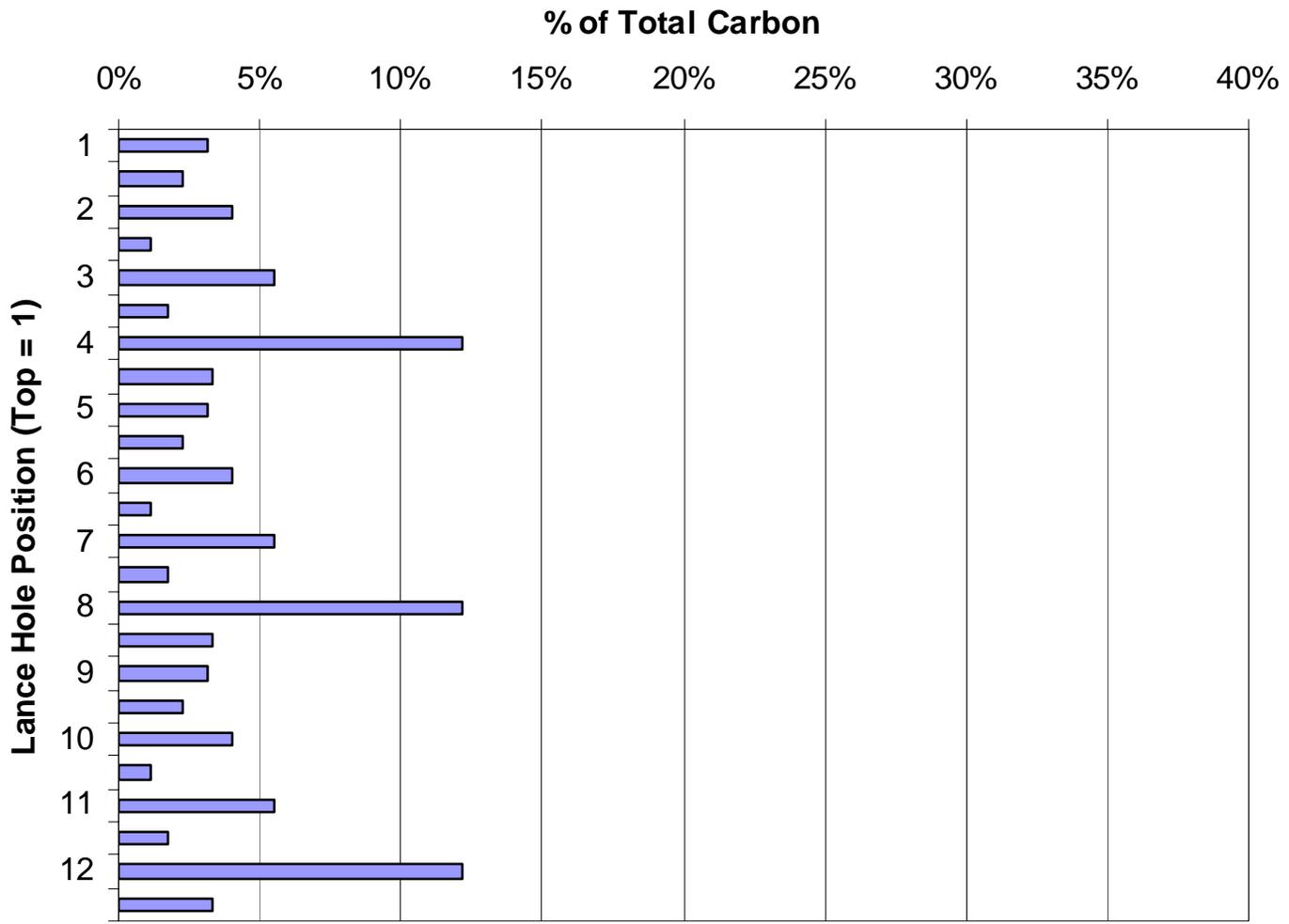
- Finalize and test new grid design in ADA-ES lab
- Fabricate and install new grid in 2006
- Parametric and 30-day test scheduled for 2007

# New Design – High Load



# New Lance Design Carbon Distribution

Top



Bottom

# Economics Comparisons (ESPs)

Plant	Coal	Sorbent	Removal (%)	Sorbent Cost (mills/kWh)
Pleasant Prairie	PRB	DARCO <sup>®</sup> Hg	67	1.2
Brayton Point	Bit	DARCO <sup>®</sup> Hg	90	2.4
Meramec	PRB	DARCO <sup>®</sup> Hg-LH	90	0.74
Independence	PRB	DARCO <sup>®</sup> Hg-LH	70	1.68
		<i>Projected with new lances</i>	70	0.26
			90	0.91

# Importance of Additional Testing

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- TOXECON II™ should provide a low-cost alternative for mercury control
- Goals for future Independence tests
  - Improve mercury removal efficiency
  - Minimize sorbent use
    - Manage costs
    - Minimize potential of increased particulate emissions
  - Assess impact of injection on particulate emissions (through EPRI funding)

# Contacts

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